INTRODUCTORY SUMMARY:

UNITED STATES ACTION PLAN FOR THE RESTORATION OF NATURAL WATER CYCLES AND CLIMATE

BY MICHAL KRAVČÍK AND JAN LAMBERT

EDITING FOR SUMMARY BY JAN LAMBERT

Note: This draft is a preliminary introduction for a description of a working document that is being presented to US audiences and stakeholders during a March/April 2017 United States tour by Dr. Michal Kravčík, a Slovakian hydrologist and climate scientist, as the central theme of his presentations in the Northeast and California. The USAP will be further developed during the course of Dr. Kravčík's meetings in the US, and will expand in the coming months.

DEFINITION OF TERMS AS USED IN THIS DOCUMENT

Sensible heat – heat that can be sensed by humans and measured, generated when the sun's rays strike surfaces; as opposed to **latent heat** contained in evaporation as required to convert liquid water to vapor, without change of temperature.

Heat islands- land areas (usually urban) that are significantly warmer than surrounding rural areas due to human development; heat islands are caused by heat radiating from paved surfaces, rooftops, and sparsely vegetated ground.

Small water cycle - a closed circulation of water in which water evaporated on land falls in the form of precipitation over this same terrestrial environment; in contrast to the **large water cycle**, which is the exchange of water between oceans and continents.

Evapo-transpiration – the dual evaporative process by which moisture is carried chiefly through plants from roots to leaves, where it changes to vapor and is released to the atmosphere, in addition to evaporation from land and its freshwater surfaces.

New Water Paradigm and Old Water Paradigm- please refer to chart at end of document

FOREWORD:

A "new water paradigm" is necessary to address heat waves, drought, floods, and severe storms that are increasingly wreaking havoc in the US. Michal Kravčík argues that the "old water paradigm" of conventional rainwater management calls for wastefully draining precipitation from rural and urban lands directly to streams, thus disrupting nature's small, local water cycles. The urgent task now is to retain as much rainwater as possible in cities, agricultural lands, forests and deserts — indeed in all of the world's landscape ecosystems — so that life-giving moisture can permeate soil, replenish groundwater, and rise into the atmosphere to regulate temperature and rainfall, instead of ultimately draining into the oceans and contributing to sea level rise. Plants influence the climate greatly by regulating the water cycle and the huge solar energy flows linked to it.

Human disregard of the need to return precipitation to ecosystems, Kravčík says, is a major factor in the escalation of climate change. Dry soils and paved surfaces increase local temperatures and reduce precipitation over a larger affected area, as well as preventing natural sequestration of carbon in the soil. Removing vegetation from an ecosystem dries out the soil, and removing water from an ecosystem reduces vegetation. Taken together, these processes are hastening desertification of the planet and intensifying global warming. Even if we reverse greenhouse gas emissions, Kravčík says, this will not stop climate change unless we change how we manage water. Restoring local water cycles, however, will in turn reverse the large portion of climate change that is directly linked to the excess drainage of all continents and the accompanying massive generation of sensible heat.

In the 1990s, Dr. Kravčík recognized that his nation of Slovakia was advancing an ecologically questionable and economically inefficient water policy. With his organization People and Water, and with support of the Slovak River Network and Slovak Union of Conservationists, he developed *Water for the Third Millennium*, an alternative, integrated water management plan. The program has reformed water management institutions by using the principle of subsidiarity for decentralized economic power and ownership; thus People and Water is part of a larger effort for sustainable village and regional development. In the Upper Torysa region, for example, the organization has implemented projects such as a family farm, a biological wastewater treatment plant, small hydropower installations, and a small fish farm. With the money from his Goldman Environmental Prize (1999), Kravcik endowed the Blue Torysa Foundation in the 25 villages of a region in Eastern Slovakia. With its six basic grant programs, the foundation encourages local action to improve the quality of life of communities and save cultural heritage. The foundation also supports the development of civic democracy and broadens ethnic tolerance.

Michal Kravcik's work is recognized internationally through grants and fellowships, and has attracted media interest in many countries, including the USA, Austria, the Czech Republic, Germany, Canada, Australia, Portugal, South Korea, the UK, Sweden, Bulgaria, Macedonia, Kazakhstan, Estonia, France, Japan and Poland. As he points out, industry and agriculture in both the global North and South each benefit, as forests and wetlands are restored, as cities are ringed with green, and as ecologically sound local employment is created.

1. The Goal of the United States Action Plan (USAP)

Standard water management in the United States is often based on the assumption that the amount of water within the hydrologic (water) cycle remains constant, and that the balance of water within the water cycle cannot be altered. Therefore, legislation and investments into water works tend to focus on exploiting water via the utilization of surface waters, which are collected within artificial reservoirs and subsequently distributed for various needs. Other forms and locations of water are often considered too inaccessible to be used; in other words, the costs of accessing them exceed the benefits. Furthermore, the category of stormwater includes all types of precipitation, in the form of rain or snow, which are not only devalued by industrial waste and surface pollutants, but also frequently drained away as a waste product from human altered landscapes.

The integrity of the natural circulation of water in the small (or short) water cycles of ecosystems, through the evaporation of water from ecosystems into the atmosphere, the formation of clouds, and their condensation and precipitation, forms the basis for the long-term sustainability and permanent renewal of water in small water cycles. The driver of this permanent circulation of water in nature is the sun's energy.

By underestimating the impacts of human activity on the emptying of water from small water cycles, we are depleting the quantity of freshwater found in the US. The degradation of landscapes caused by poor management of rainwater results not only in the dehydration of ecosystems, but also the depletion of small water cycles. The result is not only greatly diminished rainfall, but also an increasing inability of chronically dehydrated soils in ecosystems to retain any rainfall that does occur. The result is increased risk of flooding with its attendant erosion and the subsequent decrease of organic matter in the soil, leading to the loss of soil fertility. It is of critical importance that excess sensible heat is generated by depleted, uncovered soil and paved or impervious surfaces. Urban areas in particular add to the water cycle imbalance by channeling stormwater into storm sewers from the extensive impervious surfaces common in modern cities, towns, and transportation corridors. Unfortunately, rainwater is thus managed as a waste product, usually rapidly drained away to rivers and oceans from the areas where humans reside. Water reserves are shrinking in the small water cycles and as a result soil, vegetation, climate and thermoregulation all suffer.

Large areas throughout the United States are undergoing long-term and steady dehydration. Furthermore, the US has reached a stage where the amount of heat produced from dried-out regions is so enormous, that it is negatively affecting the formation of clouds and precipitation. An example of this change was evident in 2012, when the US experienced two historical weather extremes. In the summer, there were historic droughts in the central parts of the US, and November of the same year brought historic torrential rains to the eastern seaboard.

Temperatures in the summer of 2012 reached more than 110 degrees F. causing extensive damage to agriculture. Shortage of water in the landscape resulted in the accumulation of a great quantity of heat energy from drought in the western part of the US, which prevented the frontal system of clouds from the Atlantic from flowing into the interior of the country. This led to the formation of massive cloud cover over the East Coast which in turn led to heavy rains and subsequent flooding. Moreover, although the Midwest suffers a rain deficit, that region alternates its long-term droughts with strong bursts of rain. For example, in May of 2013 intense rain caused a 100-year flood.

With proper management, rainwater could again infiltrate the land and contribute to building up water reserves in an area, thermoregulating the landscape, strengthening photosynthesis, easing weather imbalances, and revitalizing the climate. But by allowing water to leave the region as waste instead of being put to use, rainwater management across the US contributes to ecosystem damage leading to more frequent occurrences of floods, hurricanes, tornadoes, prolonged droughts, wildfires and the chronic overheating of landscapes.

The frequent flooding across the US confirms that there is a great amount of rainwater occurring with the potential to benefit long-term water resources. Changes to rainwater management could make it possible to renew land's natural production potential, increasing both agricultural output and biodiversity; in addition improved management could revitalize the climate by decreasing the risk of frequency and intensity of hurricanes, tornadoes, flooding and drought. Regular moderate precipitation can be returned to those regions suffering from drought, and rainfall intensity can be decreased to a tolerable level in those regions suffering from torrential downpours. It is possible to achieve this with rainwater that is currently treated as a waste product.

Based on the impacts of dehydration on Slovakia's landscape, which can be considered to be typical in its impact of dehydration of ecosystems, we can estimate that from the degraded areas of the United States, roughly 50 billion m^3 of rainwater, which in the past was part of the permanent circulation of water in the small water cycles, is now lost annually. This is 6.5% of the annual global loss of 760 km^3. Here it is important to see the direct link between the dehydration of the land of the entire US, as well as the rest of the world, and the rise in sea levels. It follows that this loss of 50 billion m^3 of rainwater is the USA's yearly contribution to sea level rise, 6.5% of the total. Also contributing is the pumping of water from underground aquifers, which is not returned to the hydrological cycle; but instead drained away eventually to the oceans.

It needs to be widely recognized that the dehydration process is of primary importance to ecosystems and human welfare, and that this dehydration is caused chiefly by urbanization and deforestation of the earth's surface. Annually, 127,000 km^2 of land globally falls prey to deforestation, while another estimated 55,000 km^2 of the earth's surface is paved, roofed over or drained. Particularly in the US, extensive forest fires have also caused severe damage to the land's water retention capabilities, furthering decreases in precipitation. Population growth and the spreading of urban landscapes have dramatically altered land surfaces. It is estimated that within the last 100 years, the impacts of damaged ecosystems have led to the loss of 37,000 km^3 of fresh water from small water cycles on all continents, with the US share comprising more than 2,500 km^3. Urbanization trends in the US have experienced unprecedented growth in the last twenty years and the water lost from small water cycles in the US, as mentioned previously, is now estimated at 50 billion m^3 annually,

The impact of dehydrating and paving over landscapes of the US results in the increased annual production of sensible heat into the atmosphere of more than 1.6 million TWh.(One terawatt is equal to one trillion or 10^{12} watts.) Furthermore, every year this production of heat increases by 15,000 TWh resulting in even more drought. To give an idea of the scope, the heat produced each year from dehydrated landscapes is currently roughly 500 times greater than the annual electrical power generated in the US. The distribution of precipitation is also directly linked with this phenomenon. The decrease of precipitation in drier areas is countered by the increased concentration of precipitation in relatively humid and moist areas of the country. With chaotic air masses created by heat extremes, the end result is a growth in turbulent weather such as torrential rains, more frequent and intense tornadoes, and more extreme hurricanes on the East Coast; and yet tragically the extreme rains often alternate with prolonged drought.

Dramatic changes to weather patterns are becoming more unpredictable each year. Harsh winters, especially in the eastern parts of the US, occur when warm air currents push their way through Europe and over the Atlantic Ocean into the region of the North Pole, from where cold air masses are pushed south into North America. The origin of dramatic changes to US weather can thus be found in the increased production of sensible heat in far-away regions such as Africa (tornadoes) and Europe (severely cold winters). There is also a likely link between drought and intensive rainfall, which develops during the condensation of water vapor in atmospheric "rivers".

Another correlation is the impact of the dehydration of continents on the earth itself. There is great likelihood that the lightening of the continents and the loading of the oceans by 37,000 billion tons of water has impacted the pressure ratios of geological structures. Here we may find a fairly accurate basis for freeing up tension in the earth's core and thus causing more frequent earthquakes than in the past.

The growth in the production of sensible heat is causing a decline of precipitation in dried out areas and the growth of precipitation in more humid and cooler areas. This also increases the temperature differences between dried out, overheated areas and more humid and colder areas. These differences can occur in close proximity within a region. A notable example is the island of Hawaii in the Pacific Ocean, where ten different precipitation belts are found on an area of 10,000 km^2. The western coast of the island receives just ten inches (250mm) of precipitation per year while the eastern coast, which is just 60 miles away, is gifted with more than 235 inches (6,000 mm) of annual precipitation.

In summary, the driving force in the increase of climate extremes is the dehydration of landscapes from lack of rainwater retention, which results in the dehydration of ecosystems. Such phenomena in arid and dry areas are often explained by the growth in greenhouse gas emissions such as CO^2 into the atmosphere. However, it is critical that attention be focused more on climatic functions based on the coexistence between vegetation and the circulation of water. These functions took millions of years to evolve, but are now being drastically disrupted by human activity through poor land and water management practices. The danger is that this large part of climate change caused by human-caused dehydration, may remain unrecognized, so that we fail to act.

However, by recognizing the direct connection between loss of rainwater from the land and undesirable changes in climate, there opens up an opportunity for real solutions. Revitalization of a destabilized climate can be realized through the renewal of water in ecosystems with programs for the consistent retention of rainwater. The renewal and protection of the natural water cycle and vegetation in dehydrated areas will not only help to stabilize climate, but will simultaneously reinstate agricultural productivity, renew biodiversity, directly curb floods, renew water resources for people, and reduce the rise in sea level with its threat to coastlines. This can be achieved only by mobilizing human effort across all levels, from local and municipal, to state and federal, and ultimately in cooperation with other nations on a global level.

Currently extremely large amounts of money that are being invested in water management in the US are systematically oriented toward the dehydration of landscapes (for example by storm sewers), which only serves to worsen the water imbalance. A stable hydrologic cycle in the land and atmosphere can be achieved only through economic activity that allows for rainwater retention. The risk of flooding, desertification and other natural disasters will only increase in the coming years, unless we undergo a fundamental change in land management and in urban development. We have a responsibility to restore dehydrated lands to bring back lost water in the soil, in ecosystems and in small water cycles.

The current situation in the US is unsustainable and dangerous. While flooding and drought is to a certain extent a natural phenomenon, intervening in natural processes by human activity, such as changes in runoff of rainwater due to urbanization, agricultural practices and deforestation, have helped to increase violent weather. The need is urgent for humans to begin the revitalization of climate via integrated ecosystem retention of rainwater.

It is necessary initially to identify those areas negatively affected, and to specify the correct processes of restoration required. The solution lies not in the expansion of existing waterworks projects, but in focusing on large-scale renewal of water in the soil and land. All states must recognize the need to enact water management policy akin to environmental protection and landscape conservation.

Effective water cycle renewal strategy consists of three basic steps; 1) to capture rainwater where it falls and retard runoff to streams; 2), to retain the water and allow it to replenish groundwater, and to be transpired through vegetation to replenish moisture in the atmosphere; 3), to allow for drainage into watercourses only after the first two steps have been completed. Measures for the integrated management of water resources for an entire water basin should have priority over isolated, fragmented flood management measures.

It is necessary for states and regions to work together and coordinate their respective water management measures to ensure that water is being returned to the small water cycle. From the standpoint of water cycles that provide sustainable water supplies, it is an incorrect assumption that evaporation of water is a loss. The true loss comes through stormwater runoff from erosion and urban stormwater drainage to streams and oceans.

Within regions and municipalities it is also necessary for drinking water, wastewater and stormwater sectors to cooperate as part of the same regional small water cycle. These sectors need to look beyond their particular areas of water usage, to understand that the source of all water for communities is the complete water cycle.

If done carefully on a national scale, the US can annually increase the supply of water resources in small water cycle by more than 50 billion cubic meters. It is necessary to implement an estimated 160m^2 of water retention measures per US citizen. This means that if all US citizens implement the retention measures in their locales, within a year, reserves of more than 50 billion m^3 can be built, which will in turn revolve through small water cycles. Such an increase can remediate water cycles within 10 years. That volume of water conservation measures needs to be created across the whole of the US (Alaska not included in the scope of this plan). If we assume a return of 50 billion m^3 to small water cycles, this will achieve a reduction in the production of sensible heat of about 35,000 Terra Watt hours and create an additional total water supply 2,500 m^3 /sec (660,430 gal/sec), which will improve the entire hydrology of all watercourses in the United States.

This is the path laid out by which it is possible to revitalize the climate in the US in the next 10 years. It will be highly effective, affordable and absolutely essential for long-term sustainability and water security. The “gentling” of weather patterns will manifest increasingly as the rehydration of US landscapes progresses.

2. Implementing the US Action Plan

The USA, with an area of 3,797,000 mi^2 and a population of 320 million, typically draws its water supply from the manipulation and extraction of surface and ground water, while excessively draining rainwater off the surface of the land into streams and the ocean. Such management causes long-term loss of water resources not only from the soil and groundwater, but also from the small water cycle. Across the US there are some local and municipal initiatives that provide a range of innovative solutions for rainwater management to improve inventory of water resources. However, their range and impact is too slight to stop the bulk of regional ecosystem dehydration.

What is urgently needed is a comprehensive approach. The need to protect against floods, drought and climate change is the largest and most important challenge facing the US and the world. Those efforts via water management based on the old water paradigm have not been very effective, because of the failure to recognize the critical role of rainwater for achieving water and climate security through restoration of the small water cycle.

The goal now must be to reverse the process of shedding water from the land to return lost water back into small water cycles. Simple and practical measures can vary depending on topography and use of the land, but all methods have the same goal-to retain water in land and vegetation as close as practicable to where it falls as precipitation. Existing natural areas, particularly wetlands, must be preserved or restored; beavers must be valued for the crucial part they play in creating wetlands and wet meadows.

In forested lands, basic measures include infiltration trenches along contour lines on slopes; waterbars in logging roads; simple catchments of earth, stone, logs and brush across gullies, followed if necessary by the replanting of trees and shrubs.

In agricultural lands, the above methods apply; additional methods to retain rainwater and soil moisture include cover crops and no-till field management; terraced cropland; farm ponds and swales; holistic intensive grazing management is beneficial for pastures and grassland areas.

In urban areas, green stormwater infrastructure, increasingly utilized for pollution control, will simultaneously retain moisture to reduce heat islands and replenish water cycles. Such methods include vegetated bioswales, green roofs, rain gardens and pervious pavements.

For many of these methods, the skills and materials needed are readily available, but the scale of implementation needs to be increased dramatically to achieve water cycle restoration and sustainability of water supplies.

3. Financial and Economic Considerations of the USA

The revitalization of US landscapes with appropriate rainwater retention measures will enhance economic, social, environmental and cultural development, thereby restoring the economy of drought and flood-ravaged regions in the US. Implementation of the program throughout the United States will enhance productive capacity of agricultural regions. Widespread rainwater retention in ecosystems and the reduction of runoff into waterways will create conditions for building up stocks of water resources nationwide. The building up of water resources is essential to long-term sustainable development.

Retained water will, in many cases, become a critically important resource for increased agricultural, urban and commercial usage; these opportunities can be further developed and promoted by governments, public institutions, and private business and civil sectors. Depending on the type of landscape in which the specific projects of the USAP will be implemented, rainwater retention will fostering biodiversity and also strengthen renewable natural resources.

In forested lands, rainwater retention will benefit reforestation, provide a source of natural high quality drinking water, and increase the volume capacity of water sources.

In agricultural and rural areas, rainwater retention will increase production potential of agricultural land by preventing moisture loss and subsequent degradation of the land, as well as reducing erosion and increasing biodiversity, while providing efficient irrigation reservoirs suitable for agriculture; economically strengthen and diversify agricultural activities, for example by creating farm ponds for raising aquatic flora and fauna; create an attractive environment for economic development of the countryside for agritourism and educational programs.

In urban landscapes, rainwater retention will be an effective means to achieving economically feasible measures for climate restoration in intensively developed environments typically made arid through extensive impervious surfaces, by use of innovative practices, such as green roofs, rain gardens, rainwater storage tanks, and other bio-technical systems for conserving water necessary for municipal services, such as firefighting and road cleaning; and integration of other innovative approaches to water management, for example by sophisticated and highly effective biotechnological municipal wastewater treatment.

Particularly in arid regions of the US, rainwater retention will be of further benefit by increasing water and food security, reducing conflict over water rights, spurring economic growth, and restoring native ecosystems and biodiversity.

Through practical implementation, revitalization, and conservation of rainwater in all national states, the USAP will not only directly fulfill its main objectives — building of flood prevention measures and reducing climate change risks — but will also create specific secondary economic benefits, incentives for innovation and demand for new technological products and services, thus creating long-term opportunities for higher employment and economic growth.

Farsighted strategic thinking and targeted support of innovation, and introduction of new processes and products in the field of efficient use of recovered rainwater from restored small water cycles, all present a unique opportunity for businesses and investors to establish themselves in a sector which has the prospect of dynamic growth in a global context. In coming years, technology companies in this sector could create for themselves a significant competitive advantage in the US economy. New markets will grow the economies of states and regions, whether rural or urban.

An essential part of the USAP program, therefore, are projects that activate innovative thinking and use professional human potential emanating from universities and academic and public research institutes, in partnership with business professionals. With effective formation of productive technology teams, multi-sector contractual partnerships will increase synergy for US technology firms, and their successful entry in the competitive international market.

In the case of university students preparing to enter the emerging new economy, a combination of technical equipment skills and academic learning, through student design and development teams, will create opportunities for effective use of the students' expertise, knowledge, and undisputed creative potential.

Support of the USAP community can not only restore rainwater to small water cycles, but may substantially contribute to recovery of economic climate as well as social and environmental security in all corners of US; the USAP provides an opportunity to create more than 3 million jobs. The intent is to restore and maintain healthy ecosystems that involve the participation of various stakeholders, including the public sector as well as various private sectors. This action will include effective use and sharing of institutional capacities as well as creative potential and technological resources, creating an integrated multi-sectoral participation model application of the USAP.

Motivation of a watershed's partnership stakeholders lies in their understanding of and commitment to restoration of small water cycles, together with determining the incentives of all stakeholders for the preparation, processing and realization of an integrated partnerships for the watershed. Multi-sector participation in startup projects, activated with support of investments, especially at the beginning stages, will be possible only through active participation of governmental, scientific, nonprofit and business sectors. This may require significant changes from the current management of watersheds, leading to more effective actions. State programs will thus become multi-faceted tools for permanent renewal of water cycles within each state's borders as well as regionally. Consolidating public finances will increase the efficiency of macroeconomic management, on the road to sustainability.

The financial resources designated for the realization of the US Action Plan, from a long-term perspective, are the most important criteria for the US to ensure environmental, economic, social and climate security for a sustainable way of life. Each state will need to address a multitude of territorial issues while simultaneously providing enough water for the daily needs of people, food production, the environment, sustainable development and small water cycle stabilization.

Legislative measures similar to clean water laws can be enacted, which will motivate landowners and managers to retain rainwater across all ecosystems (forested, agricultural, wilderness, urban). Systematic support of the utilization of rainwater for multiple uses across all sectors of the economy will provide incentives for innovation, research and development, services and job creation. These measures will encourage substantial participation of all stakeholders in the use, protection and restoration of water resources on which people, nature and climate depend.

Estimated costs can be based on the need for conserving 50 billion cubic meters of rainwater in the US. The cost of a volume of one cubic meter of conserved water under the program will be a maximum of $8 (US dollars). The total cost of the program, to build the established cyclical water retention capacity during the period of implementation of the program, will reach approximately $400 billion. Over the recommended ten year period of implementation, costs would therefore be about $40 billion per year. Implementation of the USAP and its economic multiplier effects will result in overall macroeconomic benefits which will, undeniably, far outweigh the costs of the program.

Below find costs and benefits for individual states:

	States (Excluding Alaska)	Area of State	Volume of waterholdings (From rainwater retention in land)	Amount of New water sources created	Reduction of sensible heat	Investment required	New jobs created
		Sq. miles	mil. gallons	gallons/s	TWh	mil. USD	number
1	Alabama	52419	221,905	11095	**588**	**6720**	**53760**
2	Arizona	113998	478,151	23908	**1267**	**14480**	**115840**
3	Arkansas	53179	224546	11227	**595**	**6800**	**54400**
4	California	163696	686,847	34342	**1820**	**20800**	**166400**
5	Colorado	104094	438,526	21926	**1162**	**13280**	**106240**
6	Connecticut	5543	23,775	1189	**63**	**720**	**5760**
7	Delaware	2489	10,567	528	**28**	**320**	**2560**
8	Florida	65755	277,381	13869	**735**	**8400**	**67200**
9	Georgia	59425	250,963	12548	**665**	**7600**	**60800**
10	Hawaii	10931	47,551	2378	**126**	**1440**	**11520**
11	Idaho	83570	343,424	17171	**910**	**10400**	**83200**
12	Illinois	57914	243,038	12152	**644**	**7360**	**58880**
13	Indiana	36418	153,220	7661	**406**	**4640**	**37120**
14	Iowa	56272	237,755	11888	**630**	**7200**	**57600**
15	Kansas	82277	343,424	17171	**910**	**10400**	**83200**
16	Kentucky	40409	171,712	8586	**455**	**5200**	**41600**
17	Louisiana	51840	219,263	10963	**581**	**6640**	**53120**
18	Maine	35385	150,578	7529	**399**	**4560**	**36480**
19	Maryland	12407	52,834	2642	**140**	**1600**	**12800**
20	Massachusetts	10555	44,909	2245	**119**	**1360**	**10880**
21	Michigan	96716	409,467	20473	**1085**	**12400**	**99200**
22	Minnesota	86939	367,199	18360	**973**	**11120**	**88960**

23	Mississippi	48430	203,412	10171	**539**	**6160**	**49280**
24	Missouri	69704	290,589	14529	**770**	**8800**	**70400**
25	Montana	147042	620,804	31040	**1645**	**18800**	**150400**
26	Nebraska	77354	327,573	16379	**868**	**9920**	**79360**
27	Nevada	110561	467,585	23379	**1239**	**14160**	**113280**
28	New Hampshire	9350	39,626	1981	**105**	**1200**	**9600**
29	New Jersey	8721	36,984	1849	**98**	**1120**	**8960**
30	New Mexico	121589	515,136	25757	**1365**	**15600**	**124800**
31	New York	54556	229,830	11491	**609**	**6960**	**55680**
32	North Carolina	53819	227,188	11359	**602**	**6880**	**55040**
33	North Dakota	70700	298,514	14926	**791**	**9040**	**72320**
34	Ohio	44820	190,204	9510	**504**	**5760**	**46080**
35	Oklahoma	69898	290589	14529	**770**	**8800**	**70400**
36	Oregon	98381	41,4750	20738	**1099**	**12560**	**100480**
37	Pennsylvania	46055	195,487	9774	**518**	**5920**	**47360**
38	Rhode Island	1545	7,925	396	**21**	**240**	**1920**
39	South Carolina	32020	137,369	6868	**364**	**4160**	**33280**
40	South Dakota	77116	324,932	16247	**861**	**9840**	**78720**
41	Tennessee	42143	179,637	8982	**476**	**5440**	**43520**
42	Texas	268581	1,135,940	56797	**3010**	**34400**	**275200**
43	Utah	84899	359,274	17964	**952**	**10880**	**87040**
44	Vermont	9614	39,626	1981	**105**	**1200**	**9600**
45	Virginia	42774	184,920	9246	**490**	**5600**	**44800**
46	Washington	71300	301,156	15058	**798**	**9120**	**72960**
47	West Virginia	24230	103,027	5151	**273**	**3120**	**24960**
48	Wisconsin	65498	277,381	13869	**735**	**8400**	**67200**
49	Wyoming	97814	412,108	20605	**1092**	**12480**	**99840**
50		**3130745**	**13,208,603**	**660,430**	**35,000**	**400,000**	**3,200,000**

Name of Hurricane	**Damages**
Hurricane Katrina (2005)	$105,840,000,000
Hurricane Sandy (2012)	$50,000,000,000
Hurricane Andrew (1992)	$45,561,000,000
Hurricane Ike (2008)	$27,790,000,000
Hurricane Wilma (2005)	$20,587,000,000
Hurricane Ivan (2004)	$19,832,000,000
Hurricane Charley (2004)	$15,820,000,000
Hurricane Rita (2005)	$11,797,000,000

Hurricane Agnes (1972)	$11,370,000,000
Hurricane Hugo (1989)	$9,490,000,000
	$318,087,000,000

4. USAP Timeframe

It is necessary for the US Action Plan to be implemented within the next ten years, in inter-connected stages in conjunction with global efforts. An important factor for increasing the efficiency of the program, as well as further augmenting its created multiplier effects, is the timeline for implementation. Achievement of the water retention goal can be foreseen as short (2025) to medium (2035) term, depending on the intensity of the involvement of stakeholders. The plan can be initiated at multiple levels, from federal, through state level, to regional, local municipal, and individual levels. Often the negotiation process from top to bottom is complex, so it is easier to start from the bottom up at the individual level and gradually evolve to the regional, state and federal level.

Implementation of the USAP in each state will begin the process of returning lost water to the small water cycles and micro-climate of each state. The USAP can unite states toward a common purpose of water renewal, and enable state legislatures to develop and approve measures utilizing all stakeholder groups, including managers and owners of forested, agricultural, and urban lands. By employing the USAP, state governments can begin the implementation of projects in their most degraded regions, which will in turn become real-life test labs for further developing technological processes for capturing and harvesting rainwater.

Pilot projects can be implemented, under new legislation as well as under the current institutionalized management, for integrated protection of water. This provision will provide a useful source and effective feedback for enacting legislative changes and institutional reforms for the effective management, use, protection and renewal of water resources.

Regional program implementation builds upon the preceding phase and will be deployed after individual state legislation is in effect, to develop efficient management of river basins within and between regions, including rules and regulations for financing, organizing and managing the USAP.

5. Concluding Remarks

The US has one strategically valuable natural resource: water, and one talented, but yet underrealized, intangible resource: human potential. The USAP opens up opportunities for the optimization of human potential through new technologies and new products and services. It creates opportunities for efficient, yet environmentally sensitive and cautious usage of this blue planet's potential, and the start of restoration of damaged landscapes by the realized return of water to small water cycles.

The economic potential of all the earth's resources can be multiplied by the synergy that is created and supported through creation of the USAP, through its strategies based on the processes of the natural world combined with human potential. The opportunities for innovation in the rainwater management sector will generate a desirable and creative economic growth and a significant contribution to long-term solutions to US problems, including desertified and degraded lands, lack of clean water, and the resultant poverty and civil unrest.

The total contribution of the USAP could in fact be incalculably higher, by creating environments nationwide in which it will be possible to safely work, operate a business, and enjoy a good quality of life. Benefits which statisticians do not currently include in GDP growth figures will include massive relief from water stress and a major increase of financial investment by those who recognize the vast opportunities for new business.

Thus an economy based on local renewal of water cycles provided by the USAP will create conditions for improving the quality of life, even in the parts of the US territory where there is presently a dire lack of water. Vast areas of previously arable land have become dry and barren through humanity's mismanagement of rainwater over the past decades and centuries. Restoring these lands by harvesting rainwater to the earth and local small water cycles will inexpensively ease the great burdens of everyday life suffered by much of the US population. The USAP will provide abundant water resources to support not only the vast biodiversity of healthy ecosystems but also increasing human populations.

Lacking water, very little improvement of ecological degradation, poverty and strife is possible; with water, everything is possible. The US Action Plan can lead the way to water security for all, and renewed hope for much increased peace and prosperity, for a revitalized landscape emerging from restored lands and climates. We invite all stakeholders, citizens of all nations, of all walks of life public or private, to join in a cooperative effort to help restore life-giving small water cycles in America.

Resources:

Water for the Recovery of the Climate-A New Water Paradigm, ed. Michal Kravčík http://www.waterparadigm.org/download/Water_for_the_Recovery_of_the_Climate_A_New_Water_Paradigm.pdf

A Global Action Plan for the Restoration of Natural Water Cycles and Climate, by Michal Kravčík and Jan Lambert http://bio4climate.org/downloads/Kravcik_Global_Action_Plan.pdf

Old water paradigm	New water paradigm
The water on land does not influence global warming, which is caused by the growth in the volume of greenhouse gases produced by human activity.	An important factor in global warming may be the change in the water cycle caused by the drying and subsequent warming of continents through human activity.
The subject of research is the impact of global warming on the water cycle.	The subject of research is the impact of changes in the water cycle on global warming.
Urbanization, industrialisation and economic exploitation of a country has minimal impact on the water cycle.	Urbanization, industrialisation and economic exploitation of a country (over about 40% of the area of the continents) has a fundamental impact on the influence of the water cycle.
The impact of humanity on the water cycle is negligible and changes in the cycle cannot be reversed by human activity.	The impact of humanity on the water cycle is at present considerable and its changes can go in both directions.
Adverse climatic trends will increase, mitigation can perhaps be expected within a horizon of centuries.	If the new approach to water is applied, a possible recovery of the climate can be expected within decades.
Interest in the large water cycle, which seems difficult to influence, is dominant while the significance of the small water cycle is trivialized.	Interest in the small water cycle dominates.
The reason for extreme weather effects is global warming .	The reason for extreme weather effects are changes in the water cycle.
Global warming and extreme weather effects are inextricably linked.	Global warming can exist without extremes of weather, extremes of weather can exist without global warming.
Global warming is the main climatic problem for humanity.	Extremes of weather are the main climatic problem for humanity.
Vegetation is not ideal from the viewpoint of global warming because it has a low albedo (reflectivity); water vapor again increases the greenhouse effect.	Water and vegetation alleviate unwanted temperature differences; cloudiness moderates the intensity of solar radiation falling on the Earth's surface.
Speaks about the atmosphere as a greenhouse covering of the Earth.	Speaks about the atmosphere as a protective covering for the Earth.
Rising ocean levels are a result of melting icebergs.	Rising ocean levels are a result of melting glaciers on land, but also of a decrease in soil moistures, levels of groundwater and the state of other waters on landmasses.
Rainwater is an inconvenience and needs to be quickly removed.	Rainwater is an asset that needs to be retained in soil/plants.[57]
The main source and reserve of water is surface water.	The main source and reserve of water is groundwater.
There is an impersonal attitude by owners and users of land (citizens, companies and offices) towards rainwater in a territory.	A change in the anonymous approach to rainwater on an individual's land and the creation of a spirit of shared responsibility for water resources.
Water is used only once for one purpose and then is sluiced away.	Water can be used for more purposes, then purified and recycled.[58]
Water supplied to communities primarily through a system of mains with "potable" quality water.	Water supplied through a system divided into potable and utility water.
Mutual isolation of public policies in relation to water.	Policies in relation to water are based on a thorough perception of water in the scope of a functioning water cycle in a country.
A sectoral approach to managing water resources on land.	Integrated management of water resources in a territory.

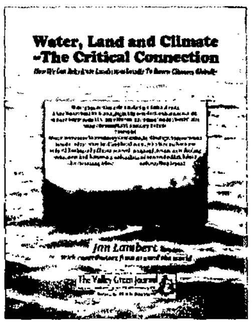
Water, Land and Climate – The Critical Connection:
How We Can Rehydrate Landscapes Locally To Renew Climates Globally
by Jan Lambert, with contributors from around the world

In nature water, plants, and soils all function together harmoniously with the atmosphere toabsorb and regulate the flow of precipitation. Natural landscapes provide a "giant sponge" with ample vegetation and deep root systems and soil life that absorb water easily, replenish groundwater, and release a cooling cloud-forming water vapor, via plant transpiration, into the atmosphere to later fall as rain. This is the essence of the regional, local or small water cycle.

For centuries humankind has greatly interfered with small water cycles by way of poor agricultural methods and deforestation that bare the soil. More recently has come massive urban and road development, where rain is often treated as a waste product termed "stormwater." Urban areas and roads not only prevent stormwater from entering the ground with pavement and rooftops, but also drain the runoff directly into rivers, lakes, and oceans with downspouts, storm drains, and pipes. Stormwater runoff is a major source of water pollution as well as contributing to flooding, drought, and diminished fresh water supplies. Furthermore, less water into the land leads to less plant growth, the plants so greatly needed as prime regulators of climate through evapo-transpiration. By contrast paved areas contribute directly to regional and global warming by transforming solar energy into intense heat that also contributes to more severe winds as well as drought.

Human intervention is needed quickly, by way of a new water paradigm,* to "jumpstart" the process of restoration in seriously degraded or paved-over landscapes; the good news is that community actions will add up to globally positive effects.

Find out how we can all contribute to restoring vital small water cycles!



Water, Land and Climate – The Critical Connection **was published in October 2015 as a major resource publication of Stormwater and Landscapes Education (SWALE), a special focus of *The Valley Green Journal*. The purpose of SWALE is to provide resources and networking tools to address the critical importance of retaining and infiltrating rain and snowmelt into landscapes degraded by deforestation, agriculture, and urban development.**

Order at www.valleygreenjournal.com.

***For a free download on the New Water Paradigm, click below; also see summary chart on reverse side of this page.**

http://www.waterparadigm.org/download/Water_for_the_Recovery_of_the_Climate_A_New_Water_Paradigm.pdf

A comparison of starting points and approaches according to the old and the new water paradigm

Old water paradigm	New water paradigm
The water on land does not influence global warming, which is caused by the growth in the volume of greenhouse gases produced by human activity.	An important factor in global warming may be the change in the water cycle caused by the drying and subsequent warming of continents through human activity.
The subject of research is the impact of global warming on the water cycle.	The subject of research is the impact of changes in the water cycle on global warming.
Urbanization, industrialisation and economic exploitation of a country has minimal impact on the water cycle.	Urbanization, industrialisation and economic exploitation of a country (over about 40% of the area of the continents) has a fundamental impact on the influence of the water cycle.
The impact of humanity on the water cycle is negligible and changes in the cycle cannot be reversed by human activity.	The impact of humanity on the water cycle is at present considerable and its changes can go in both directions.
Adverse climatic trends will increase, mitigation can perhaps be expected within a horizon of centuries.	If the new approach to water is applied, a possible recovery of the climate can be expected within decades.
Interest in the large water cycle, which seems difficult to influence, is dominant while the significance of the small water cycle is trivialized.	Interest in the small water cycle dominates.
The reason for extreme weather effects is global warming .	The reason for extreme weather effects are changes in the water cycle.
Global warming and extreme weather effects are inextricably linked.	Global warming can exist without extremes of weather, extremes of weather can exist without global warming.
Global warming is the main climatic problem for humanity.	Extremes of weather are the main climatic problem for humanity.
Vegetation is not ideal from the viewpoint of global warming because it has a low albedo (reflectivity); water vapor again increases the greenhouse effect.	Water and vegetation alleviate unwanted temperature differences; cloudiness moderates the intensity of solar radiation falling on the Earth's surface.
Speaks about the atmosphere as a greenhouse covering of the Earth.	Speaks about the atmosphere as a protective covering for the Earth.
Rising ocean levels are a result of melting icebergs.	Rising ocean levels are a result of melting glaciers on land, but also of a decrease in soil moistures, levels of groundwater and the state of other waters on landmasses.
Rainwater is an inconvenience and needs to be quickly removed.	Rainwater is an asset that needs to be retained in soil/plants[1]
The main source and reserve of water is surface water.	The main source and reserve of water is groundwater.
There is an impersonal attitude by owners and users of land (citizens, companies and offices) towards rainwater in a territory.	A change in the anonymous approach to rainwater on an individual's land and the creation of a spirit of shared responsibility for water resources.
Water is used only once for one purpose and then is sluiced away.	Water can be used for more purposes, then purified and recycled[2]
Water supplied to communities primarily through a system of mains with "potable" quality water.	Water supplied through a system divided into potable and utility water.
Mutual isolation of public policies in relation to water.	Policies in relation to water are based on a thorough perception of water in the scope of a functioning water cycle in a country.
A sectoral approach to managing water resources on land.	Integrated management of water resources in a territory.

[1] „A Paradigm Shift for Water Management". Rocky Mountain Institute, www.rmi.org

[2] ibid.